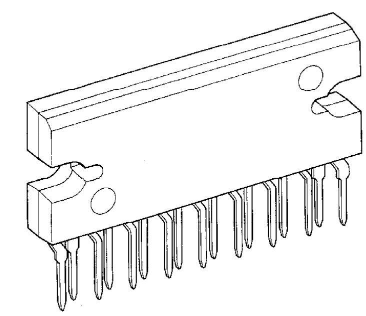
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8220H

30W BTL × 2CH AUDIO POWER AMPLIFIER

The thermal resistance θj-T of TA8220H package designed for low thermal resistance, has high efficiency of heat radiation.
The temperature rise of chip can be reduced, and the influence from the degradation of the features due to the temperature rise at the high output can also be reduced.
This stereo audio power IC, designed for car audio use, has two built-in channels to reduce the Characteristic difference between L and R channels. It also contains output short detection circuit, output clip detection and various kind of protection.



HZIP17-P-2.00

Weight : 9.8g (Typ.)

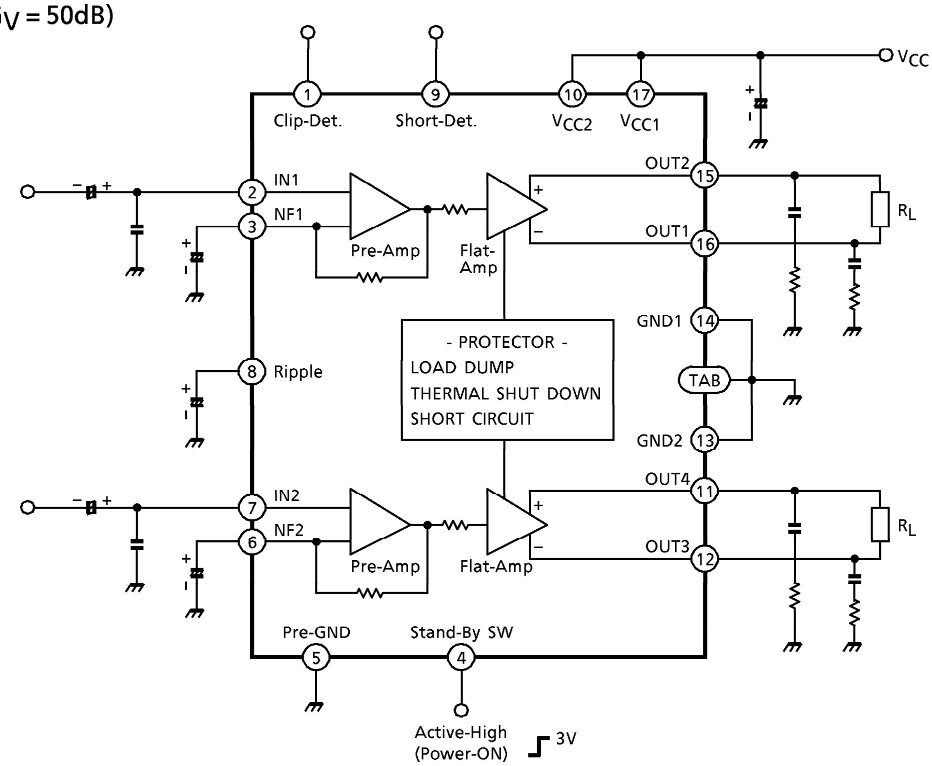
FEATURES

- Low Thermal Resistance : θj-T = 1.5°C / W (Infinite Heat Sink)
- High Power : P_{OUT} (1) = 30W (Typ.) / Channel
  (V_{CC} = 14.4V, f = 1kHz, THD = 10%, R_L = 2Ω)
  : P_{OUT} (2) = 26W (Typ.) / Channel
  (V_{CC} = 13.2V, f = 1kHz, THD = 10%, R_L = 2Ω)
  : P_{OUT} (3) = 19W (Typ.) / Channel
  (V_{CC} = 13.2V, f = 1kHz, THD = 10%, R_L = 4Ω)
- Low Distortion Ratio : THD = 0.04% (Typ.)
  (V_{CC} = 13.2V, f = 1kHz, P_{OUT} = 1W, R_L = 4Ω, G_V = 50dB)
- Low Noise : V_{NO} = 0.30mV_{rms} (Typ.)
  (V_{CC} = 13.2V, R_L = 4Ω, G_V = 50dB, R_g = 0Ω, BW = 20Hz~20kHz)
- Built-in Stand-by Function (With ④pin set at LOW, power is turned OFF.) : I_{SB} = 1μA (Typ.)
- Built-in Output Short Detection Circuit (⑨pin : Open Collector)
- Built-in Output Clip Detection Circuit (①pin : Open Collector)
- Built-in Various Protection Circuits
  Protection Circuits : Thermal Shut Down, Over Voltage, Out→V_{CC} Short, Out→GND Short and OUT-OUT Short.
- Operating Supply Voltage : V_{CC} = 9~18V

961001EBF1

BLOCK DIAGRAM

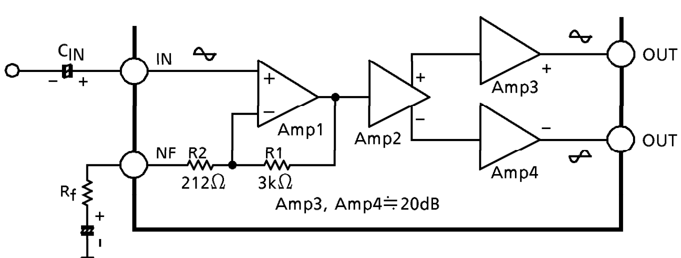
TA8220H ($G_V = 50dB$)



CAUTION AND APPLICATION METHOD

(Description is made only on the single channel.)

1. Voltage gain adjustment



(Fig.1)

Amp1 : Pre-Amp
Amp2 : Phase Amp
Amp3 : POWER Amp (Flat-Amp)
Amp4 : POWER Amp (Flat-Amp)

This IC has the amplifier constructions as shown Fig.1. The Pre-Amp (Amp1) is provided to the primary stage, and the input voltage is amplified by the Flat Amps, Amp3 and Amp4 of each channel through the phase Amp (Amp2).
Since the input offset is prevented by Pre-Amp when V_{CC} is set to ON, this circuit can remarkably reduce the pop noise.

The total closed loop gain G_V of this IC can be obtained by expression below when the closed loop voltage gain of Amp1 is G_{V1}.

$$G_{V1} = 20\ell og \frac{R1 + (R_f + R2)}{R_f + R2} \quad (dB) \cdots\cdots\cdots (1)$$

The closed loop voltage gain of POWER Amp, Amp3 and Amp4 is fixed at $G_{V3} \fallingdotseq G_{V4} = 20dB$.
Therefore, the total closed circuit voltage gain G_V is obtained through BTL connection by the expression below.

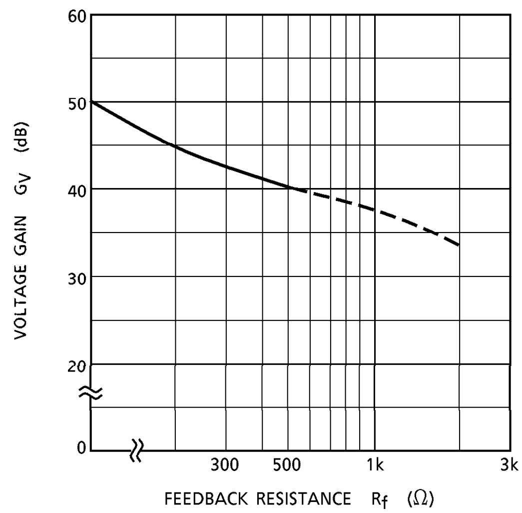
$$G_V = G_{V1} + G_{V3} + 6 \quad (dB) \cdots\cdots\cdots (2)$$

For example, when $R_f = 0\Omega$, G_V is obtained by the expressions (1) and (2) as shown below.

$$G_V \fallingdotseq 24 + 20 + 6 = 50dB$$

The voltage gain is reduced when R_f is increased. (Fig.2)

With the voltage gain reduced, since (1) the oscillation stability is reduced, and (2) the pop noise changes when V_{CC} is set to ON, refer to the items 3 and 4.



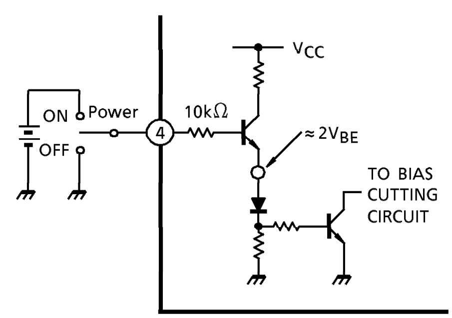
(Fig.2)

2. Stand-by SW function

By means of controlling ④pin (Stand-by terminal) to High and Low, the power supply can be set to ON and OFF. The threshold voltage of ④pin is set at 2.1V ($3V_{BE}$), and the Power Supply current is about 1μA (Typ.) at the stand-by state.

Control Voltage of ④pin : $V_{(SB)}$

Stand-By	Power	$V_{(SB)}$ (V)
ON	OFF	0~2
OFF	ON	3~V_{CC}

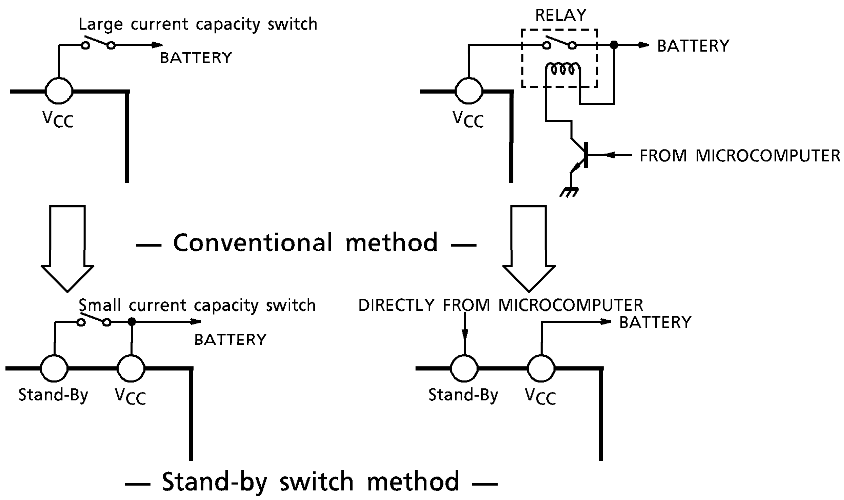


(Fig.3) With ④pin set to high, power is turned ON.

<Adjustage of stand-by SW>

(1) Since V_{CC} can directly be controlled to ON / OFF by the microcomputer, the switching relay can be omitted.

(2) Since the control current is microscopic, the switching relay of small current capacity is satisfactory for switching.



3. Preventive measure against oscillation

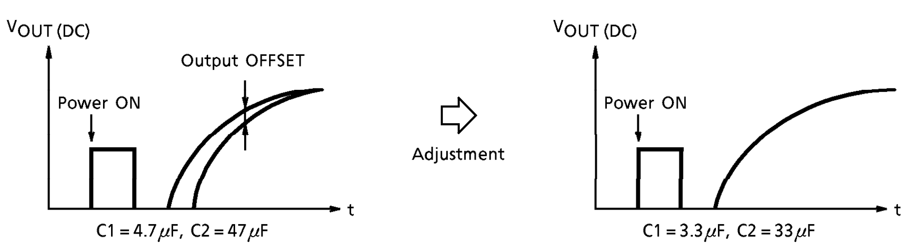
   For preventing the oscillation, it is advisable to use C4, the condenser of polyester film having small characteristic fluctuation of the temperature and the frequency.
   The condenser (C6) between input and GND is effective for preventing oscillation which is generated with a feedback signal from a output stage.
   The resistance R to be series applied to C4 is effective for phase correction of high frequency, and improves the oscillation allowance.

   (1) Voltage gain to be used (G_V setting)
   (2) Capacity value of condenser
   (3) Kind of condenser
   (4) Layout of printed board

   In case of its use with the voltage gain G_V reduced or with the feedback amount increased, care must be taken because the phase-inversion is caused by the high frequency resulting in making the oscillation liable generated.

4. Adjustment of output offset (When the power supply turn on)
   As this IC is constructed with DC circuit on the Pre-Amp stage, it is necessary to lower a input offset or output offset by agreement with the each leading edge time constant of the input voltage in the Pre-Amp stage and NF terminal voltage.
   Concretely, monitor the output DC voltage and vary the capacity value in input condenser and NF condenser (See Fig.4)

   (Reference) In case of setting the condition (G_V = 40dB) with R_f = 470Ω.

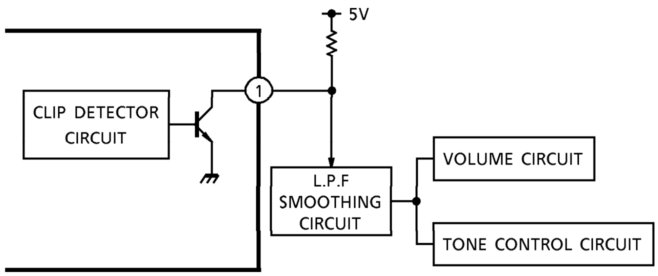


(Fig.4)

5. Output clip detection function (Pin ①)

The output clip detection terminal of pin ① has the open collector output structure on clip as shown in Fig.5. In case that the output waveform is clipping, the clip detection circuit is operated and NPN Tr. is turned on.
It is possible to improve the tone quality with the current of flowing into pin ① and with controlling the volume, tone·control circuit through L.P.F smoothing circuit as shown in Fig.5.
In case of being unused this function, use this IC as open connection on pin ①.

(Application)

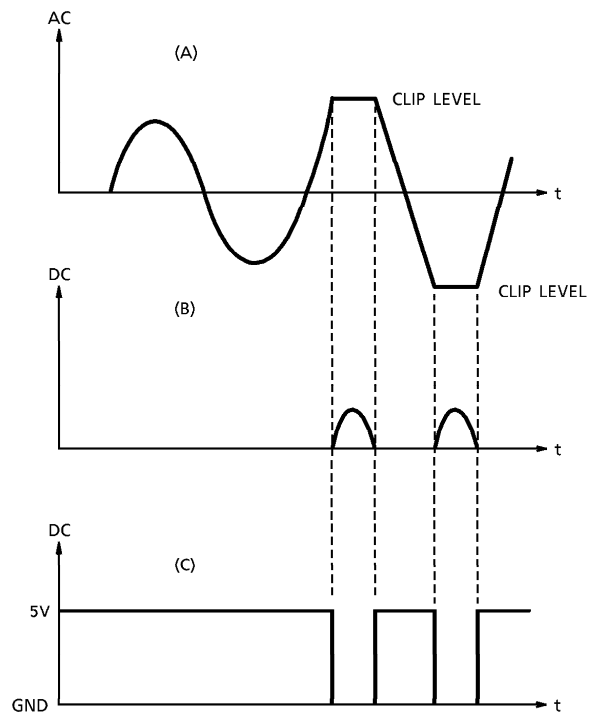


(Fig.5) ①pin : Open collector output (Active low)

(A) Output

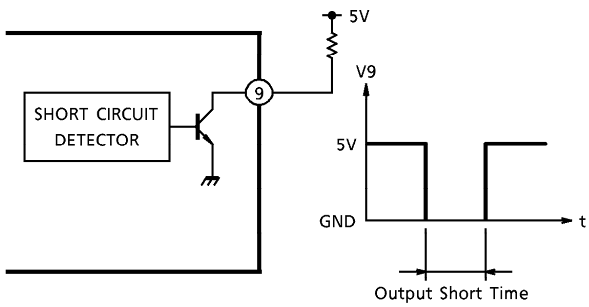
(B) Clip detector circuit

(C) Clip detector terminal (①pin output)

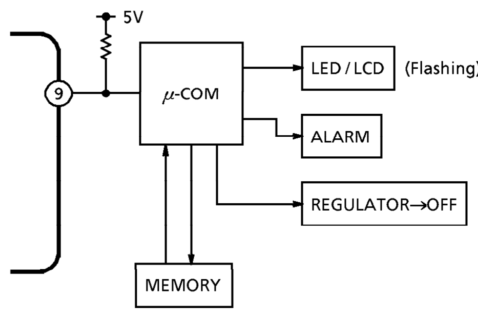


6. Output to V_{CC}, output to GND detection function (Pin ⑨)

The Output Short Detection Terminal of pin ⑨ has open collector output structure on chip as shown in Fig.6.
In unusual case that output terminal of Power Amp. is condition of output to V_{CC} or Output to GND Short, it is possible to protect all the system of apparatus as well as Power IC protection.
In case of being unused this function, use this IC as open-connection on pin ⑨.



(Application)



⑨pin : Open Collector Output (Active Low)

(Fig.6)

7. External part list and description

SYMBOL	RECOMMENDED VALUE	FEATURE	INFLUENCE		REMARKS
			SMALLER THAN RECOMMENDED VALUE	LARGER THAN RECOMMENDED VALUE	
C1	4.7μF	DC blocking	Related to pop noise at V_{CC}→ON.		Related to gain. Refer to item 4.
C2	47μF	Feedback condenser	Related to pop noise at V_{CC}→ON. Determination of low cut-off frequency $C2 = \frac{1}{2\pi \cdot f_L \cdot R_f}$		
C3	220μF	Ripple reduction	Time constant is small at V_{CC}→ON or OFF.	Time constant is large at V_{CC}→ON or OFF.	
C4	0.12μF	Oscillation prevention	Made liable to oscillate.	Oscillation allowance	Refer to item 3.
C5	1000μF	Ripple filter	For filtering power supply hum and ripple. Large at using AC rectified power supply. Small at using DC power supply.		
C6	1000pF	Oscillation prevention	Oscillation allowance improved. Noise Reduction		Refer to item 3.

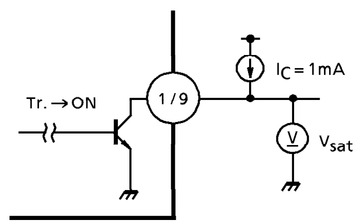
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Peak Input Voltage (0.2s)	$V_{IN\ (surge)}$	50	V
DC Supply Voltage	$V_{IN\ (DC)}$	25	V
Operating Supply Voltage	$V_{IN\ (opr)}$	18	V
Output Current (Peak)	$I_{O\ (peak)}$	9	V
Power Dissipation	P_D	50	W
Operating Temperature	T_{opr}	−30~85	°C
Storage Temperature	T_{stg}	−55~150	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC} = 13.2V, R_L = 4Ω, f = 1kHz, Ta = 25°C)

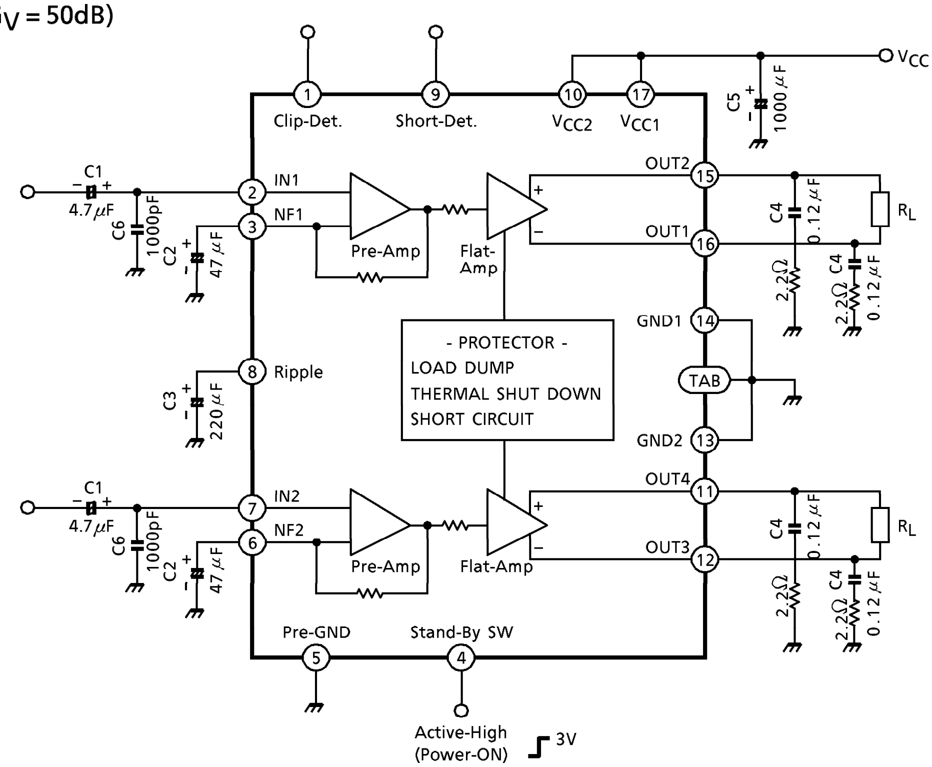
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Supply Current	I_{CCQ}	—	V_{IN} = 0	—	120	250	mA
Output Power	$P_{OUT\ (1)}$	—	V_{CC} = 14.4V, R_L = 2Ω, THD = 10%	—	30	—	W
	$P_{OUT\ (2)}$	—	R_L = 2Ω, THD = 10%	17	26	—	
	$P_{OUT\ (3)}$	—	THD = 10%	16	19	—	
Total Harmonic Distortion Ratio	THD	—	P_{OUT} = 1W	—	0.04	0.4	%
Voltage Gain	G_V	—		48	50	52	dB
Voltage Gain Ratio	ΔG_V	—		−1.0	0	1.0	dB
Output Noise Voltage	V_{NO}	—	R_g = 0Ω, BW = 20Hz~20kHz	—	0.3	0.7	mV_{rms}
Ripple Rejection Ratio	R.R.	—	f_{ripple} = 100Hz, R_g = 600Ω	40	54	—	dB
Input Resistance	R_{IN}	—		—	30	—	kΩ
Output Offset Voltage	V_{offset}	—	V_{IN} = 0	−100	0	100	mV
Current at Standard-By State	I_{SB}	—		—	1	10	μA
Cross Talk	C.T.	—	R_g = 600Ω, V_{OUT} = 0.775V_{rms} (0dBm)	—	60	—	dB
④pin Control Voltage	V_{SB}	—	Stand-By→OFF (Power→ON)	2.5	—	V_{CC}	V
①pin (CLIP DET) Saturation Voltage	V_{sat} ①	—	I_C = 1mA	—	100	—	mV
⑨pin (SHORT DET) Saturation Voltage	V_{sat} ⑨	—	I_C = 1mA	—	100	—	mV

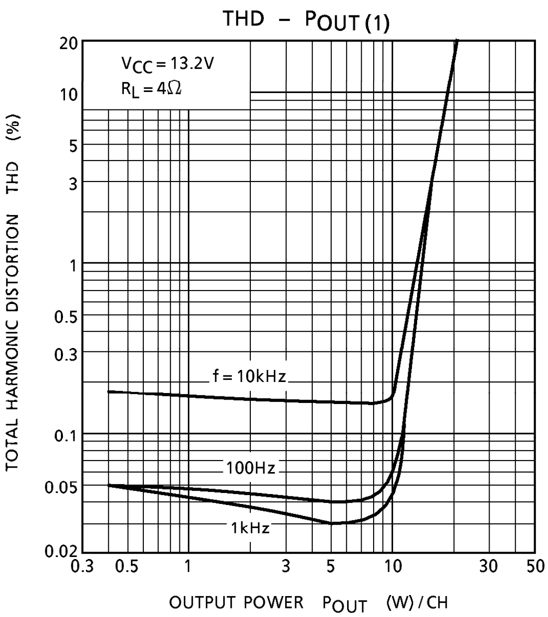
V_{sat} ①, V_{sat} ⑨ TEST CIRCUIT

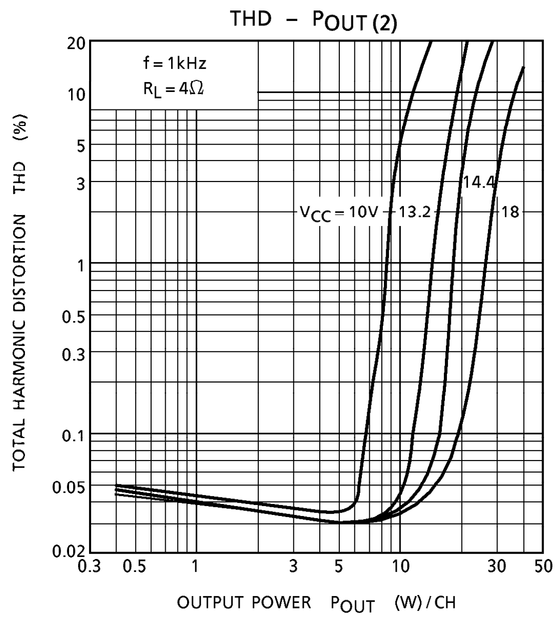


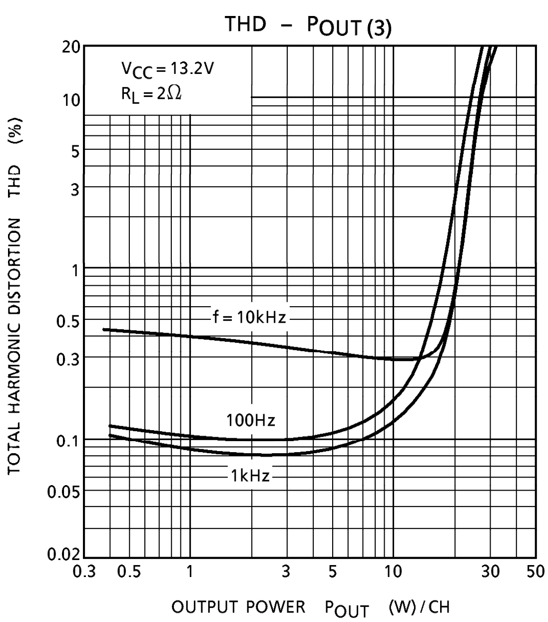
TEST CIRCUIT

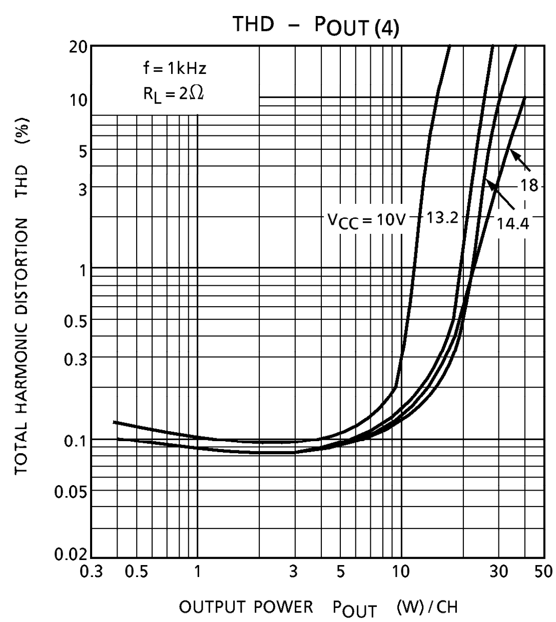
TA8220H (G_V = 50dB)

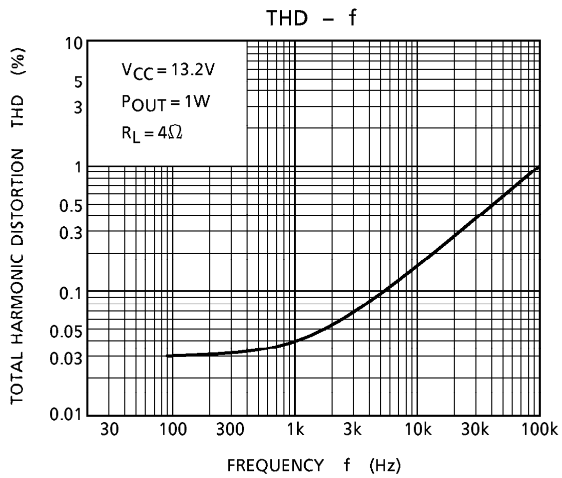


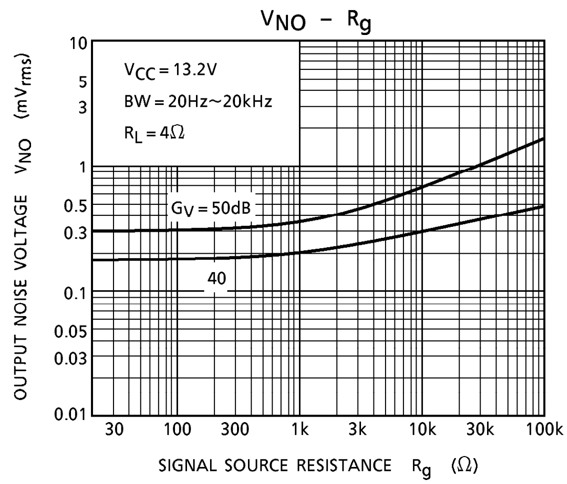

THD – POUT (1)
VCC = 13.2V
RL = 4Ω
f = 10kHz
100Hz
1kHz
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W) / CH
20
10
5
3
1
0.5
0.3
0.1
0.05
0.02
0.3
0.5
30
50

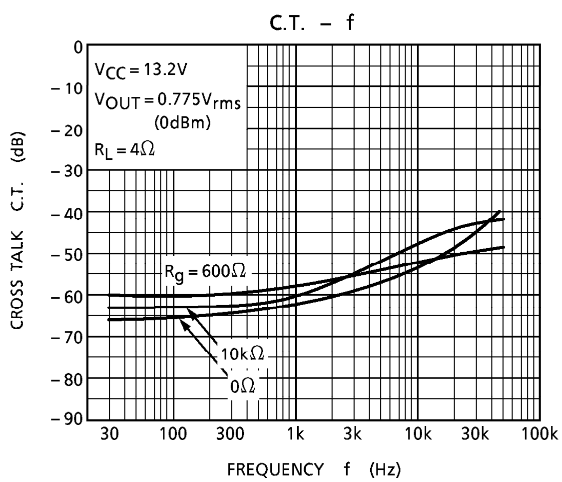

THD – POUT (2)
f = 1kHz
RL = 4Ω
VCC = 10V
13.2
14.4
18
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W) / CH

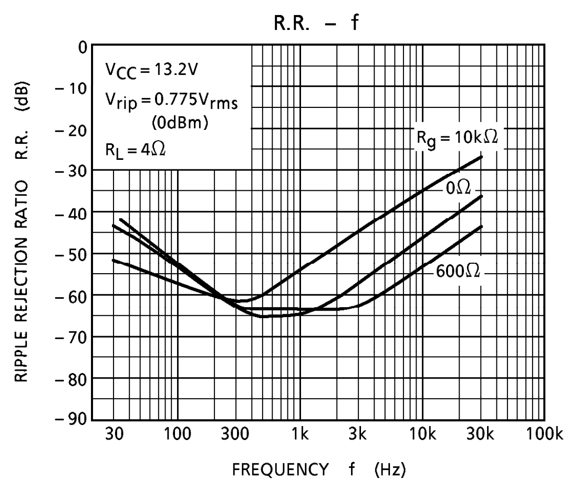

THD – POUT (3)
VCC = 13.2V
RL = 2Ω
f = 10kHz
100Hz
1kHz
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W) / CH

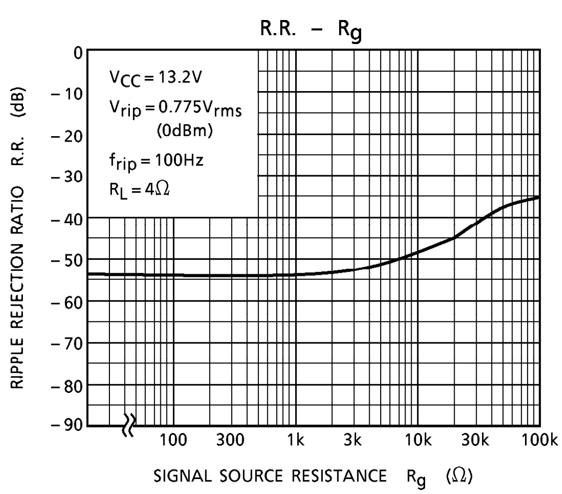

THD – POUT (4)
f = 1kHz
RL = 2Ω
VCC = 10V
13.2
18
14.4
TOTAL HARMONIC DISTORTION THD (%)
OUTPUT POWER POUT (W) / CH

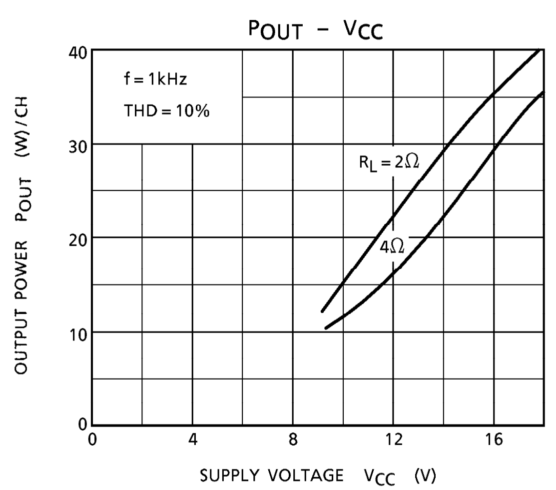

THD – f
VCC = 13.2V
POUT = 1W
RL = 4Ω
TOTAL HARMONIC DISTORTION THD (%)
FREQUENCY f (Hz)

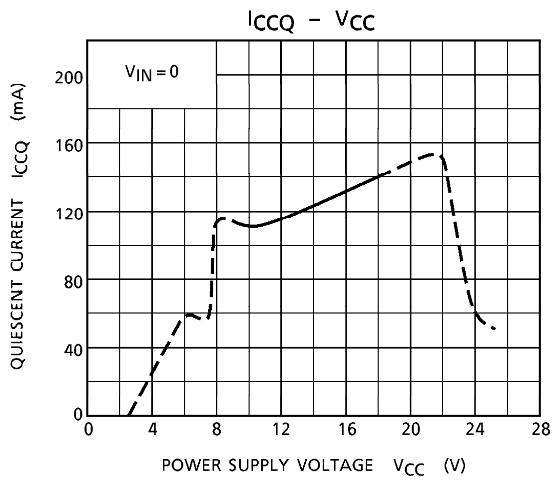

VNO – Rg
VCC = 13.2V
BW = 20Hz~20kHz
RL = 4Ω
GV = 50dB
40
OUTPUT NOISE VOLTAGE VNO (mVrms)
SIGNAL SOURCE RESISTANCE Rg (Ω)

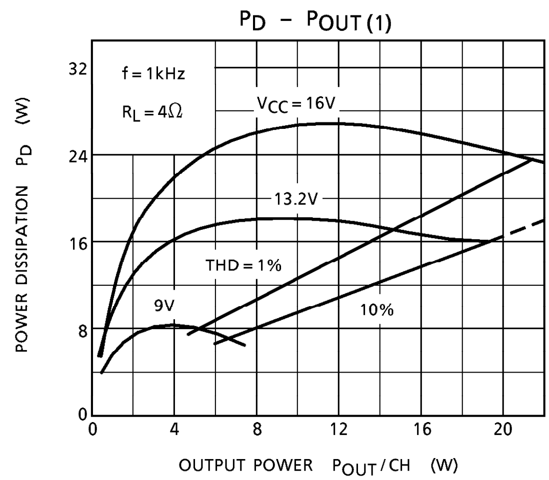

C.T. – f
VCC = 13.2V
VOUT = 0.775Vrms
(0dBm)
RL = 4Ω
Rg = 600Ω
10kΩ
0Ω
CROSS TALK C.T. (dB)
FREQUENCY f (Hz)

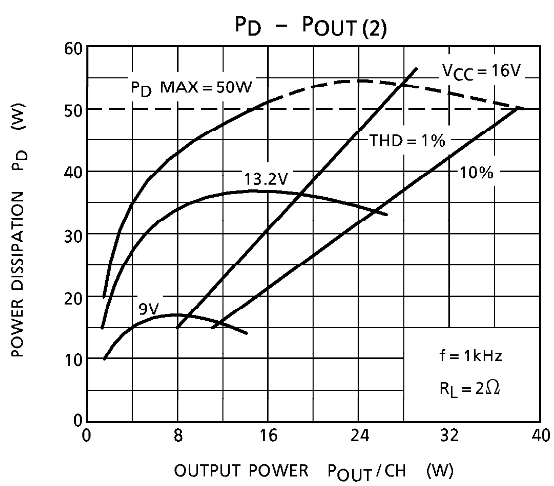

R.R. – f
VCC = 13.2V
Vrip = 0.775Vrms
(0dBm)
RL = 4Ω
Rg = 10kΩ
0Ω
600Ω
RIPPLE REJECTION RATIO R.R. (dB)
FREQUENCY f (Hz)

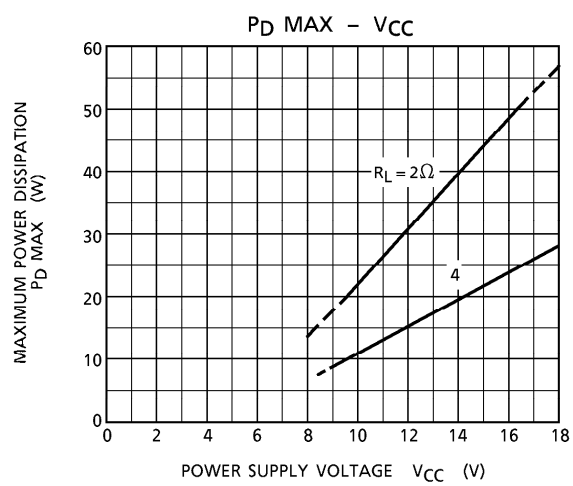

R.R. – Rg
VCC = 13.2V
Vrip = 0.775Vrms
(0dBm)
frip = 100Hz
RL = 4Ω
RIPPLE REJECTION RATIO R.R. (dB)
SIGNAL SOURCE RESISTANCE Rg (Ω)

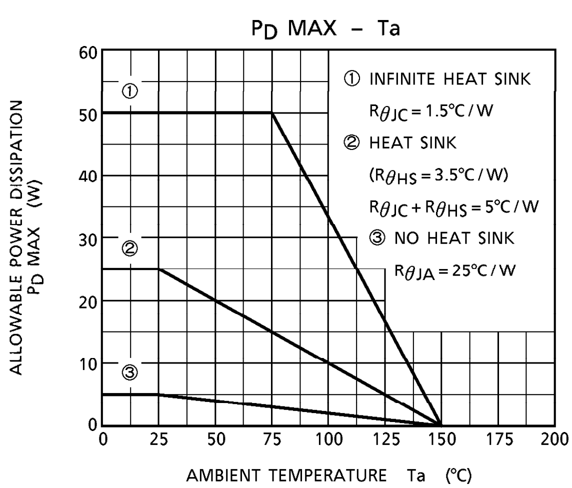

POUT – VCC
f = 1kHz
THD = 10%
RL = 2Ω
4Ω
OUTPUT POWER POUT (W)/CH
SUPPLY VOLTAGE VCC (V)


ICCQ – VCC
VIN = 0
QUIESCENT CURRENT ICCQ (mA)
POWER SUPPLY VOLTAGE VCC (V)

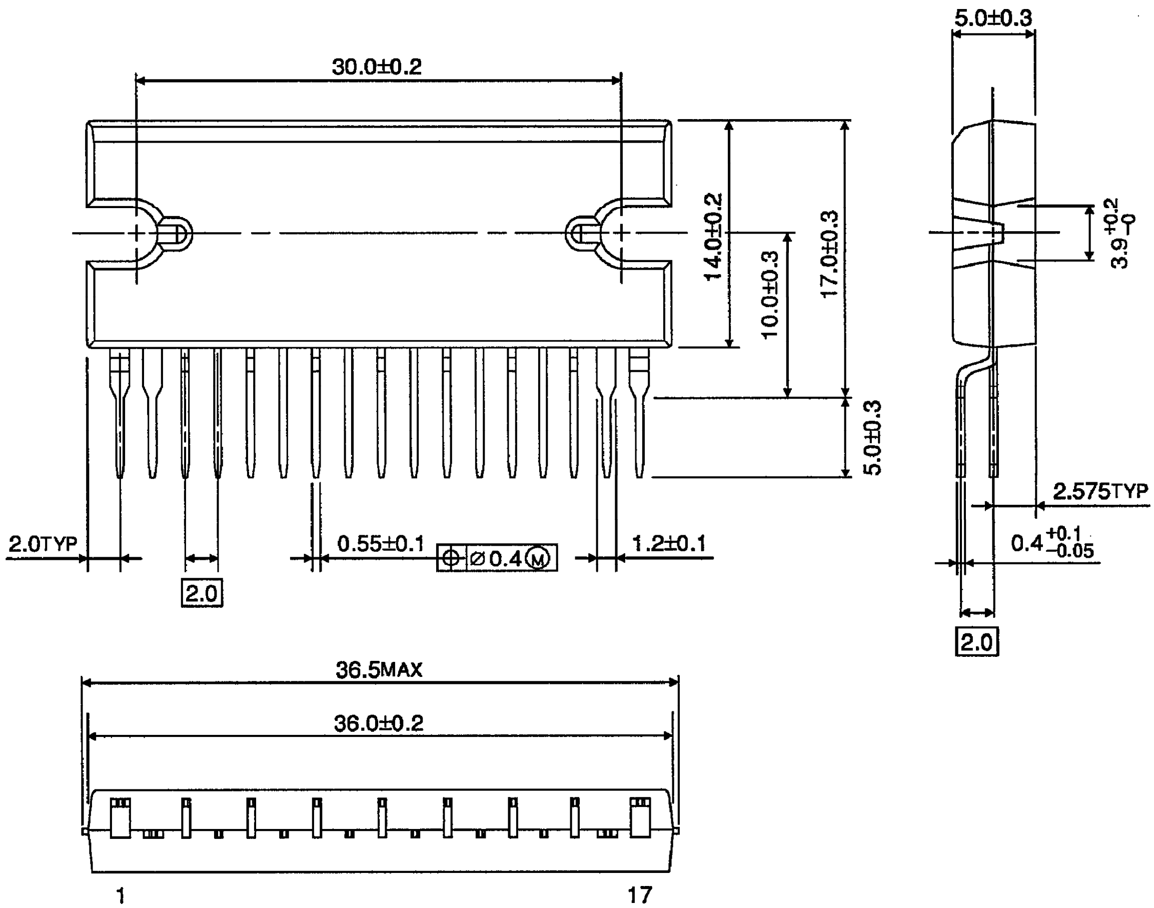

PD – POUT (1)
f = 1kHz
RL = 4Ω
VCC = 16V
13.2V
THD = 1%
9V
10%
POWER DISSIPATION PD (W)
OUTPUT POWER POUT / CH (W)


PD – POUT (2)
PD MAX = 50W
VCC = 16V
THD = 1%
13.2V
10%
9V
f = 1kHz
RL = 2Ω
POWER DISSIPATION PD (W)
OUTPUT POWER POUT / CH (W)


PD MAX – VCC
RL = 2Ω
4
MAXIMUM POWER DISSIPATION PD MAX (W)
POWER SUPPLY VOLTAGE VCC (V)


PD MAX – Ta
① INFINITE HEAT SINK
RθJC = 1.5°C / W
② HEAT SINK
(RθHS = 3.5°C / W)
RθJC + RθHS = 5°C / W
③ NO HEAT SINK
RθJA = 25°C / W
ALLOWABLE POWER DISSIPATION PD MAX (W)
AMBIENT TEMPERATURE Ta (°C)

OUTLINE DRAWING
HZIP17-P-2.00



Weight : 9.8g (Typ.)